REMARKS

I. Introduction:

Claim 7 is amended and new claims 13-15 are added herein. With entry of this amendment, claims 1-15 will be pending.

Claims 7-9 were objected to as being dependent upon a rejected base claim. Claim 7 has been amended to include the requirements of claim 1. Accordingly, claim 1 is believed to be in proper form for allowance. Claims 8 and 9, depending directly from claim 7, now depend from an allowable claim and are themselves in proper form for allowance.

The present invention is directed to high definition conformal arc radiation therapy with a multi-leaf collimator. The system and method, as set forth in the claims, provide for radiation to a first treatment field delivered as the collimator is moved through a first arc and radiation to a second treatment field delivered as the collimator is moved through a second arc with the leaves of the collimator rotated relative to the delivery for the first treatment field. The multi-leaf collimator may be rotated, for example, ninety degrees about an axis extending generally perpendicular to the leaves. Applicant's invention is particularly advantageous in that improved resolution and conformation to the contour of the treatment field is achieved without changing current multi-leaf collimator leaf widths or using lead alloy blocks specially designed for each radiation treatment.

II. Claim Rejections Under 35 U.S.C.§103(a):

Claims 1, 2-6, and 10-12 stand rejected under 35 U.S.C.§103(a) as being unpatentable over U.S. Patent No. 5,818,902 (Yu).

Claim 1 is directed to a method for delivering radiation from a radiation source to a treatment area and includes: (a) positioning a multi-leaf collimator between the radiation source and the treatment area to block a portion of the radiation and define a first treatment field, the collimator being positioned with leaves of the collimator extending longitudinally in a first direction; (b) moving the multi-leaf collimator through a first arc over the treatment area while delivering radiation through the first treatment field to the treatment area; (c) rotating the multi-

leaf collimator about a central axis extending generally perpendicular to a plane containing at least a portion of the leaves such that the leaves define a second treatment field; and (d) moving the multi-leaf collimator through a second arc over the treatment area while delivering radiation through the second treatment field to the treatment area.

Yu discloses intensity modulated arc therapy with dynamic multi-leaf collimation. The apparatus utilizes continuous gantry motion in an arc about a patient (as illustrated by the orbit "O" shown in broken lines in Fig. 1) to deliver radiation to target tissues. The gantry is also movable along the long axis of the couch, as indicated by arrow B in Fig. 1. The gantry includes a multi-leaf collimator which changes leaf positions during gantry rotation about the arc, resulting in changes to field shape during gantry rotation. The method includes delivering two-dimensional beam intensity distribution at different arc rotations.

As noted by the Examiner, Yu does not explicitly disclose rotating the multi-leaf collimator about a central axis such that leaves define a second treatment area and moving the collimator through a second arc over the treatment area while delivering radiation through the second treatment field. Yu achieves altered treatment fields by moving leaves of the multi-leaf collimator as the gantry moves through the arc. The gantry in Yu, however, is not rotated about an axis extending perpendicular to the leaves, as set forth in claim 1. The size of the treatment field and variation between different intensities is limited in Yu to a cell area defined by the width of a collimator leaf, since the leaves can only move along one axis. Applicant's method provides for improved resolution and contour conformation by rotating the gantry about an axis perpendicular to the leaves. Rotation of the gantry about this perpendicular axis to the leaves, allows a treatment area to be defined with variable width along two axes. In contrast, the system of Yu moves leaves of the multi-leaf collimator along only one axis as the gantry moves in an arc about a patient.

Accordingly, claim 1 is submitted as patentable over Yu and the other prior art of record.

Claims 2-6 and 10-11, depending either directly or indirectly from claim 1, are submitted as patentable for the reasons discussed above with respect to claim 1.

Claim 12 is directed to a system for delivering radiation from a radiation source to a treatment area. The system includes a collimator having multiple leaves for blocking radiation from the source and defining an opening between the radiation source and the treatment area and

a controller. The controller is configured to position the leaves to define a first treatment field, move the collimator through a first arc, rotate the collimator about a central axis of a radiation beam emitted from the radiation source, position the leaves to define a second treatment field, and move the collimator through a second arc.

As discussed above, Yu does not show or suggest a controller configured to rotate the collimator about a central axis of a radiation beam emitted from the radiation source such that the leaves of the multi-leaf collimator can move along two different axes. Accordingly, claim 12 is submitted as patentable over Yu and the other prior art of record.

New claims 13 and 14, depending either directly or indirectly from claim 12, are submitted as patentable for the same reasons as claim 12.

New claim 15 is generally similar to claim 1 and includes the limitations of dividing a treatment area into a plurality of cells each having a defined treatment intensity level and grouping the cells to form a plurality of matrices defining treatment fields.

III. Conclusion:

In view of the foregoing, reconsideration and allowance of claims 1-12 and consideration and allowance of new claims 13-15 are respectfully requested.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE TO THE APPLICATION

IN THE CLAIMS:

Claim 7 has been amended as follows:

7 (Amended). [The method of claim 1 further comprising:] A method for delivering radiation from a radiation source to a treatment area, comprising:

dividing said treatment area into a plurality of cells each having a defined treatment intensity level;

grouping the cells to form a plurality of matrices, each of the matrices having at least one dimension approximately equal to a width of the collimator leaf; [and]

decomposing each of the matrices into orthogonal matrices to identify a plurality of treatment fields;

positioning a multi-leaf collimator between the radiation source and the treatment area to block a portion of the radiation and define a first treatment field, the collimator being positioned with leaves of the collimator extending longitudinally in a first direction;

moving the multi-leaf collimator through a first arc over the treatment area while delivering radiation through the first treatment field to the treatment area;

rotating the multi-leaf collimator about a central axis extending generally perpendicular to a plane containing at least a portion of the leaves such that the leaves define a second treatment field; and

moving the multi-leaf collimator through a second arc over the treatment area while delivering radiation through the second treatment field to the treatment area.

New claims 13-15 have been added as follows:

13 (New). The system of claim 12 further comprising a processor configured to divide said treatment area into a plurality of cells each having a defined treatment intensity level, group the cells to form a plurality of matrices, and decompose each of the matrices into orthogonal matrices to identify a plurality of treatment fields.

14 (New). The system of claim 13 wherein each of the matrices has at least one dimension approximately equal to a width of the collimator leaf.

15 (New). A method for delivering radiation from a radiation source to a treatment area, comprising:

dividing said treatment area into a plurality of cells, each having a defined treatment intensity level, and grouping the cells to form a plurality of matrices defining treatment fields;

positioning a multi-leaf collimator between the radiation source and the treatment area to block a portion of the radiation and create a first treatment field defined by a least one of said plurality of matrices, the collimator being positioned with leaves of the collimator extending longitudinally in a first direction;

moving the multi-leaf collimator through a first arc over the treatment area while delivering radiation through the first treatment field to the treatment area;

rotating the multi-leaf collimator about a central axis extending generally perpendicular to a plane containing at least a portion of the leaves such that the leaves define a second treatment field defined by at least one of said plurality of matrices; and

moving the multi-leaf collimator through a second arc over the treatment area while delivering radiation through the second treatment field to the treatment area.